CONFRONTING POSTHARVEST DECAY IN QUARANTINE-TREATED COMMODITIES

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Many fruits and vegetables must be disinfested to prevent the export of indigenous pests. With the deregistration of the chemical fumigants that had previously been used for treating these commodities, physical methods are increasingly employed as quarantine treatments. Heat, cold, and irradiation can successfully eliminate pest infestations, but treatments that injure insect pests can easily damage plant products as well. After quarantine treatment, fruits and vegetables are often more susceptible to decay-causing microorganisms.

The extreme conditions of quarantine treatment upset the metabolism of plant cells, just as they do those of the insect invaders. Structural and enzymic proteins are degraded, as well as the nucleic acids with which new proteins could be constructed. Cellular membrane systems lose their dif- permeability and compartmentalization. Treatments are designed to be less damaging to the commodity than to the pest; the pest dies (or at least cannot reproduce), whereas the fruit or vegetable should be able to persist through the marketing channels. One should realize, however, that after harvest the commodity begins to senesce and that extreme treatments only hasten the demise. Prestorage at an intermediate temperature often helps the commodity adapt to a subsequent treatment and maintains plant health.

When healthy, plants can resist pathogens through active and passive defenses. Recognition systems alert plant cells to invasion by incompatible microbes, and a cascade of events limits the spread of disease. On a simpler level, nutrients in fruits and vegetables are sequestered within cells surrounded by walls that are difficult for most microbes to penetrate. When subjected to extremes of heat or cold or to irradiation, normal senescence is accelerated, and nutrients begin to leak into intercellular spaces where they may be scavenged by microorganisms. The destruction of some plant cells by quarantine treatment, and the damage to others, can promote decay.

Adapting the quarantine treatment to take into consideration the tolerance of the commodity is of paramount importance. Examples include treating lychees at 1.1°C rather than at 46°C, mangoes at 46°C instead of at 50°C, and longans with gamma irradiation at 300 Gy in place of cold treatment. Grapefruit can tolerate either heat or cold treatment if properly applied. Heat treatment is valuable for markets that are nearby since a three-week period of cold storage can be avoided. However, a treatment of 2 hours in water at 48°C, although speedier, is more damaging than a 3-hour treatment in moist air at the same temperature. Both increase susceptibility to the fungus that causes green mold, *Penicillium digitatum,* but fruit heated more slowly in air have a longer shelf-life.

If a treatment is sufficiently good that taste and appearance are maintained but increased susceptibility to decay is a problem, countermeasures are available. The fungicide imazalil is often routinely applied to citrus to prevent the spread of green mold in cold storage. This chemical is also effective against anthracnose on mango, caused by the fungus *Colletotrichum gloeosporioides,* but this particular use has not received registration. Since many pathogens begin *their assault* on treated commodities by scavenging nutrients that leak from within, application of competing microbes to the fruit surface is an effective control measure. Strains of the yeast *Candida oleophila* and *the bacterium Pseudomonas syringae* have been registered for application to citrus and Pome fruits and reduce decay through biocontrol. These microbes colonize wounds received during Postharvest handling and prevent pathogens from becoming established. Application may be in waxes that are concurrently applied to improve appearance and reduce dehydration. The application of C. *oleophila* in a shellac coating increased the shelf-life of heat-treated grapefruit from 105 to 165 days at 13°C; this was equivalent to the shelf-life of fruit that were not quarantine-treated. Compared with shellac formulations, coatings based upon hydroxypropyl cellulose and methylcellulose extended the *s*helf-life of treated grapefruit regardless of the incorporation of biocontrol agents.

Fruit coatings based upon shellac, carnauba, candelilla, or polyethylene waxes, cellulose, sucrose esters, etc. alter levels of oxygen and carbon dioxide within commodities. These manipulations influence health of the commodity and decay susceptibility, but some materials, such as the sucrose esters are also bacteriostatic. Coatings derived from chitin foster the development of epiphytic microbes that break down the cell walls of fungal pathogens. Acidic coatings derived from carrageenan completely inhibit anthracnose on cold-treated lychees, but favor development of *Penicillium.*

The shelf-life of some commodities actually benefits from quarantine treatment The *Colletobichum* that infects mangoes enters when the fruit are young and lies quiescent until fruit are mature Hot-water treatment at 46° to 48°C not only eradicates fruit fly infestations, it can reduce subsequent anthracnose decay from 65 to 90%. Additions of calcium to the treatment water, or of anti-oxidants such as -ascorbic acid, can fortify the plant tissue and reduce decay susceptibility.

Although Postharvest decay in quarantine-treated commodities can be serious, it definitely need not be a factor in the eventual acceptability of a treatment.